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Formulation and Evaluation of a *Clitoria ternatea*-Based Herbal Face Mask for Cosmetic Applications

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ABSTRACT
The increasing demand for herbal cosmetics has stimulated the development of safe, effective, and eco-friendly plant-based skincare products. *Clitoria ternatea* (butterfly pea), a medicinal plant rich in anthocyanins, flavonoids, and phenolic compounds, possesses antioxidant, anti-inflammatory, and antimicrobial properties. The present study aimed to formulate and evaluate a powder-based herbal face mask containing *Clitoria ternatea* flower powder along with Multani mitti, rose petal powder, neem leaf powder, aloe vera powder, orange peel powder, beetroot powder, and rice powder. Three formulations (F1, F2, and F3) were prepared and evaluated for organoleptic characteristics, pH, spreadability, washability, skin compatibility, short-term stability, preliminary phytochemical screening, and total ash value. Qualitative phytochemical analysis confirmed the presence of flavonoids and anthocyanins in all formulations, with a total ash value of 27.5% w/w. The formulations exhibited pleasant odour, smooth texture, and pH values between 6.4 and 6.9. Among them, F3 showed superior spreadability, good skin compatibility without irritation, and remained stable with no significant changes in colour, odour, texture, or pH after 15 days of storage. These findings suggest that the developed *Clitoria ternatea*-based herbal face mask is a stable and promising formulation for routine cosmetic application, although further studies are required to evaluate its antioxidant activity, microbiological quality, and long-term stability.
Keywords: *Clitoria ternatea*; Herbal face mask; Herbal cosmetics; Phytochemical screening; Formulation and evaluation; Skin compatibility

Introduction

Skin is the largest organ of the human body and acts as the first protective barrier against physical injury, harmful microorganisms, ultraviolet radiation, and environmental pollutants. In addition to its protective role, it helps regulate body temperature, provides sensory perception, and supports vitamin D synthesis. Because skin, particularly the face, is continuously exposed to external environmental factors, maintaining healthy skin has become an important aspect of personal care. Everyday exposure to dust, pollution, sunlight, and changing weather conditions, along with stress and hormonal changes, can lead to problems such as acne, pigmentation, dryness, premature ageing, and loss of skin radiance. As a result, facial skin care products are widely used to cleanse, protect, and improve the appearance of the skin.

Many conventional cosmetic products contain synthetic preservatives, fragrances, colouring agents, and surfactants that may cause skin irritation, allergic reactions, or contact dermatitis, particularly after prolonged or repeated use [12,15]. Growing consumer awareness regarding the safety of cosmetic ingredients has increased the demand for herbal products prepared from naturally derived plant materials [3,27]. Herbal cosmetics are widely regarded as a safer alternative because they contain bioactive phytochemicals. They may help protect and maintain healthy skin while reducing dependence on synthetic ingredients. Plant-derived flavonoids, phenolic compounds, tannins, and other secondary metabolites are frequently incorporated into cosmetic formulations because of their reported antioxidant, antimicrobial, and anti-inflammatory properties.

Among the different types of cosmetic products, herbal face masks remain one of the most popular formulations for routine skin care. Depending on their composition, face masks may be prepared as clay, cream, gel, sheet, peel-off, mud, or powder formulations [2,7]. Powder-based herbal face masks are particularly attractive because they are easy to prepare, have good storage stability, and generally require fewer preservatives, as they are mixed with water immediately before application. These characteristics make them suitable for both household and small-scale commercial preparation.

Clitoria ternatea L. (Family: *Fabaceae*), commonly known as butterfly pea or blue pea flower, is a medicinal plant widely distributed in tropical and subtropical regions. The flowers have anthocyanin pigments known as ternatins. The flowers also contain flavonoids, phenolic compounds, saponins, and other phytoconstituents that have been reported to possess antioxidant, anti-inflammatory, antimicrobial, and wound-

healing activities [16,18,25]. These biological properties make *Clitoria ternatea* a potential natural ingredient for cosmetic formulations intended to cleanse, soothe, and protect the skin.

Several recent studies have investigated the cosmetic potential of *Clitoria ternatea*. Chaudhari et al. formulated an herbal face pack containing butterfly pea flower and reported satisfactory physicochemical characteristics, good spreadability, and no evidence of skin irritation [1]. Shimpi and Pawara reviewed the use of herbal face packs and highlighted the contribution of *Clitoria ternatea* to antioxidant and skin-soothing effects [2]. Other researchers have successfully developed herbal topical formulations, including peel-off masks [21], herbal face packs [7,20], face creams [22,29], and multipurpose topical creams [19]. These studies consistently indicate that *Clitoria ternatea* can be incorporated into different cosmetic dosage forms while maintaining acceptable formulation characteristics.

Along with *Clitoria ternatea*, the present formulation includes several herbal ingredients that are widely used in cosmetic preparations because of their complementary functions. Multani mitti (Fuller's earth) acts as a natural cleansing and oil-absorbing agent, while rose petal powder helps soothe the skin and provides a pleasant natural fragrance. Neem leaf powder is commonly included for its antimicrobial properties, aloe vera powder helps maintain skin hydration and provides a soothing effect, orange peel powder contributes mild exfoliating and skin-brightening properties, beetroot powder supplies natural pigments and antioxidant phytochemicals, and rice powder serves as a gentle exfoliant while improving the texture of the formulation [14–20]. While these ingredients have individually been used in several herbal cosmetic products, studies evaluating their combined use with *Clitoria ternatea* in different formulation ratios remain limited.

Most published studies on *Clitoria ternatea*-based cosmetic formulations have focused on the preparation and evaluation of a single optimized formulation. So, there is limited information comparing different proportions of herbal ingredients within the same formulation to determine how variations in composition influence important characteristics such as spreadability, skin compatibility, pH, washability, and overall physical stability. A comparative evaluation of multiple formulations can provide useful information for selecting a composition that offers improved performance while maintaining the advantages of a natural herbal cosmetic.

Based on these considerations, the present study was undertaken to formulate three powder-based herbal face mask formulations (F1, F2, and F3) containing different proportions of *Clitoria ternatea* flower powder and selected herbal ingredients. The formulations were evaluated for organoleptic characteristics, pH, spreadability, washability, preliminary skin compatibility, short-term stability, qualitative phytochemical screening for flavonoids and anthocyanins, and total ash value. The variation in the proportions of the herbal ingredients would influence the overall performance of the formulations and help identify the most suitable composition for further development. The present investigation was limited to laboratory-scale formulation and preliminary physicochemical evaluation. Quantitative phytochemical analysis, antioxidant testing, microbiological quality assessment, and long-term or accelerated stability studies were not included in this study. These tests are recommended for future research to better confirm the quality, safety, and effectiveness of the developed herbal face mask.

Materials and Methods

Plant Material and Other Ingredients

Fresh, healthy, and disease-free flowers of *Clitoria ternatea* (butterfly pea) were collected from the Botanical Garden of Bharat Institute of Pharmacy, Ibrahimpatnam, Telangana, India (Fig 1). The collected flowers were washed thoroughly with distilled water to remove adhering dust and other foreign matter before processing. The remaining ingredients, namely Multani mitti, rose petal powder, neem leaf powder, aloe vera powder, orange peel powder, beetroot powder, and rice powder, were procured from a local commercial supplier and used without further purification.

Fig.1. *Clitoria ternatea* plant (left) and fresh flowers (right) used for preparation of the herbal face mask.

Preparation of *Clitoria ternatea* Flower Powder

Fresh flowers were washed with distilled water and shade-dried at room temperature for four to five days until a constant weight was obtained. The dried flowers were ground into a fine powder using a mechanical grinder and passed through a standard mesh sieve to obtain a uniform particle size. The sieved powder was

stored in a clean, air-tight container at room temperature until further use.

Formulation of the Herbal Face Mask

Three powder-based herbal face mask formulations, designated F1, F2, and F3, were prepared by varying the proportions of *Clitoria ternatea* flower powder and the selected herbal ingredients while maintaining a constant batch weight of 30 g. The required quantities of *Clitoria ternatea* flower powder, Multani mitti, rose petal powder, neem leaf powder, aloe vera powder, orange peel powder, beetroot powder, and rice powder were weighed accurately using a digital weighing balance according to the composition shown in Table 1. All powdered ingredients were mixed thoroughly in a clean, dry mixing bowl using a spatula until a homogeneous blend was obtained. The prepared formulations were transferred into clean, airtight containers, labelled appropriately, and stored at room temperature until further evaluation.

Table 1: Composition of the three herbal face mask formulations (30 g batch size).

S. No.	Constituent	F1 (g)	F2 (g)	F3 (g)
1	*Clitoria ternatea* powder	6	5	6
2	Multani mitti powder	5	3	2
3	Rose petal powder	4	1	3
4	Beetroot powder	2	4	4
5	Aloe vera powder	1	4	5
6	Orange peel powder	3	5	1
7	Rice powder	4	6	5
8	Neem leaf powder	5	2	4
	Total weight	30 g	30 g	30 g

Evaluation of the Formulations

The prepared formulations were evaluated for their physicochemical characteristics using standard procedures.

Organoleptic Evaluation

Colour, odour, appearance, and texture of each formulation were assessed by visual observation and manual examination. The observations were recorded immediately after preparation.

Determination of pH

Approximately 1 g of each formulation was mixed with a sufficient quantity of distilled water to obtain a smooth paste. The pH of the freshly prepared paste was determined using standard pH paper, and the observed values were recorded for each formulation.

Spreadability

A small quantity of each formulation was mixed with distilled water to prepare a uniform paste and applied to the back of the hand. The ease of spreading and uniformity of application were observed manually and graded qualitatively as Good, Very Good, or Excellent.

Washability

Each formulation was applied to the skin, allowed to dry completely, and washed with plain water. Ease of removal and the presence or absence of any visible residue after washing were recorded.

Preliminary Skin Compatibility Test

A small quantity of each formulation was applied to a limited area of healthy skin and observed for the appearance of redness, itching, burning sensation, or any other visible signs of irritation after application. The test was performed only as a preliminary assessment of skin compatibility and not as a formal clinical evaluation.

Stability Study

The prepared formulations were stored in clean, air-tight containers at room temperature (25 ± 2°C) for 15 days. Samples were examined periodically for any visible changes in color, odor, appearance, texture, and pH. Observations recorded at the end of the storage period were compared with the initial observations to evaluate the short-term stability of the formulations.

Preliminary Phytochemical Screening

Qualitative phytochemical screening was carried out to confirm the presence of flavonoids and anthocyanins in the prepared formulations.

Test for Flavonoids

Shinoda Test: A small quantity of the sample was treated with magnesium turnings followed by a few drops of concentrated hydrochloric acid. Development of a pink to magenta color indicated the presence of flavonoids.

Alkaline Reagent Test: A few drops of 10% sodium hydroxide solution were added to the sample extract. Formation of a bright yellow colour that disappeared after the addition of diluted hydrochloric acid confirmed the presence of flavonoids.

Test for Anthocyanins

For the sulfuric acid test, 2 mL of the sample extract was treated with 1 mL of concentrated sulfuric acid. Formation of an orange-colored layer was considered a positive result. In the sodium hydroxide test, two drops of 1 M sodium hydroxide solution were added to 2 mL of the extract. Development of a blue to bluish-green colour indicated the presence of anthocyanins.

Determination of Total Ash Value

The total ash value of the formulated herbal face mask was determined by accurately weighing 2 g of the formulation into a previously ignited and weighed silica crucible. The sample was carefully charred and then incinerated in a muffle furnace maintained at 500–600°C until a light grey or white ash was obtained. After cooling in a desiccator, the crucible was weighed, and the total ash value was calculated using the following equation:

Total Ash Value (% w/w) = $[(W_3 - W_1) / W_2] \times 100$

where:

- W_1 = Weight of the empty crucible
- W_2 = Weight of the sample
- W_3 = Weight of the crucible containing the ash

Results and Discussion

Extraction Yield

An aqueous extract of *Clitoria ternatea* flowers was prepared for preliminary phytochemical screening of the plant material. Using distilled water as the extraction solvent, 10 g of dried flower powder yielded approximately 5 g of concentrated extract, corresponding to an extraction yield of about 50% under the experimental conditions employed.

Preliminary Phytochemical Screening

Qualitative phytochemical screening was carried out to confirm the presence of flavonoids and anthocyanins in the prepared samples. The observed colour changes were consistent across all three formulations. This indicates the presence of the expected phytochemical constituents.

Flavonoids: The Shinoda test produced a characteristic pink to magenta colour in formulations F1, F2, and F3, indicating the presence of flavonoids. Similar findings were obtained in the alkaline reagent test, where a bright yellow colour developed after the addition of sodium hydroxide and disappeared upon the addition of diluted hydrochloric acid. The results obtained from both qualitative tests confirmed the presence of flavonoids in all three formulations.

Anthocyanins

Anthocyanins were detected in all three formulations using two qualitative tests. Treatment with concentrated sulfuric acid produced a distinct orange-coloured layer, while the addition of sodium hydroxide resulted in the development of a blue to bluish-green colour. These observations are consistent with the characteristic anthocyanin pigments, particularly ternatins, naturally present in *Clitoria ternatea* flowers.

Total Ash Value

The total ash value of the developed herbal face mask formulation was found to be 27.5% w/w. The relatively higher ash content may be due to the presence of naturally occurring mineral-rich ingredients, particularly Multani mitti, which forms a major component of the formulation. As the product is intended as a rinse-off cosmetic preparation, the observed ash value is considered acceptable for the present formulation.

Organoleptic Evaluation

The organoleptic characteristics of the prepared herbal face mask formulations (F1, F2, and F3) were evaluated based on colour, odour, appearance, and texture. The observations are summarized in Table 2, and the physical appearance of the formulations is presented in Fig 2. All three formulations exhibited acceptable organoleptic properties. The colour of the formulations varied from light brown to deep purple depending on the proportion of *Clitoria ternatea* flower powder and beetroot powder. The formulations possessed a pleasant herbal odour due to the combined presence of rose petal powder, orange peel powder, and neem leaf powder. A fine and uniform powder texture was observed in all formulations. This indicates satisfactory blending of the ingredients without the presence of visible foreign particles or lump formation. Among the three formulations, F3 showed the most uniform appearance and smooth texture, suggesting better overall physical characteristics.

Table 2. Organoleptic characteristics of the herbal face mask formulations (F1, F2, and F3).

Parameter	F1	F2	F3
Colour	Light brown	Light brown	Light brown
Odour	Pleasant	Pleasant	Pleasant
Appearance	Fine powder	Fine powder	Fine powder
Texture	Smooth	Smooth	Smooth

Fig 2. Optimized herbal face mask formulation (F3)

Determination of pH

The pH of the prepared formulations was measured using standard pH paper after preparing a paste with distilled water. The observed pH values are presented in Table 3. The pH measurement procedure is explained in Fig 3. The pH values ranged from 6.4 to 6.9, which is close to the normal physiological pH of facial skin. This pH range suggests that the formulations are suitable for topical application and may not cause significant alteration of the skin's natural acid mantle during regular use. Minor variations in pH among the formulations may be due to differences in the proportions of the herbal ingredients.

Table 3**.** pH values of the herbal face mask formulations.

Formulation	pH
F1	6.9
F2	6.5
F3	6.4

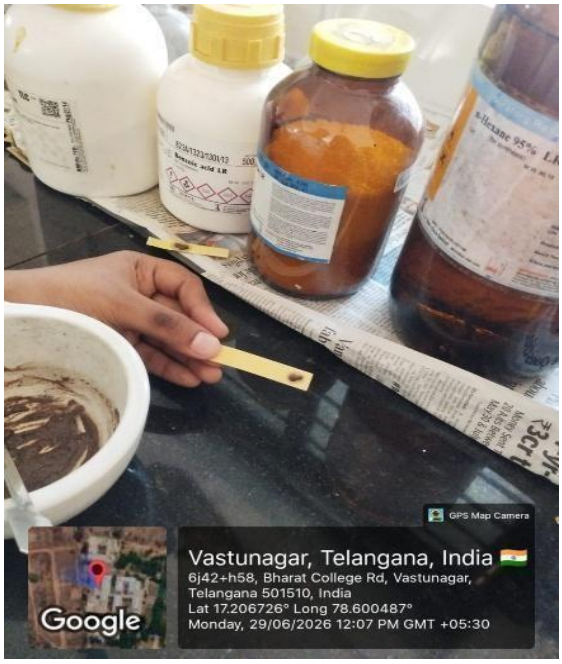

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Fig 3. Determination of pH of the prepared herbal face mask formulations using standard pH paper.

Spreadability

Spreadability is an important quality parameter that influences the ease of application and uniform distribution of a face mask over the skin. The spreadability of the formulations was assessed qualitatively. Formulation F3 exhibited excellent spreadability, whereas F1 and F2 showed good to very good spreadability. All formulations spread uniformly after mixing with water to form a smooth paste. Slight differences were observed among the formulations. Formulation F3 showed excellent spreadability, whereas F1 and F2 showed good to very good spreadability. The improved spreadability of F3 may be linked with the balanced proportion of fine powdered ingredients, resulting in a smoother paste during application.

Washability

Ease of removal after drying is an important characteristic of a facial mask because it contributes to user convenience and acceptance. Washability was evaluated after the formulations had dried completely on the skin. All formulations were removed easily with plain water without leaving noticeable residues on the skin. No excessive rubbing was required during washing, indicating satisfactory washability. The presence of rice powder and Multani mitti may have contributed to the smooth removal of the dried mask.

Preliminary Skin Compatibility Test

The formulations were subjected to a preliminary skin compatibility assessment to observe any visible signs of irritation after topical application. The observations are presented in Table 4, and the procedure is demonstrated in Fig 4. The formulations did not produce any visible redness, itching, burning sensation, or swelling during the observation period. These findings suggest that the prepared formulations were well tolerated under the conditions of this preliminary evaluation. The assessment was limited to an initial compatibility test and should not be considered a substitute for formal dermatological or clinical safety studies.

Table 4. Preliminary skin compatibility assessment of the herbal face mask formulations.

Formulation	Redness	Itching	Overall Irritation
F1	Absent	Mild	No redness or swelling
F2	Absent	Absent	No irritation
F3	Absent	Absent	No irritation

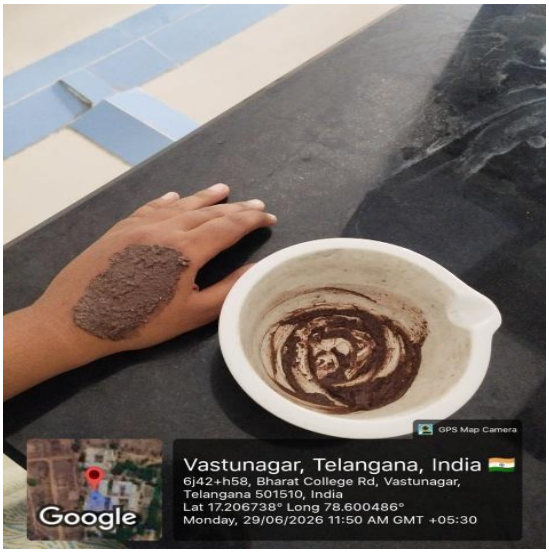

Fig 4. Preliminary skin compatibility assessment following topical application of the herbal face mask formulations.

Stability Study

Short-term stability of the prepared formulations was evaluated by storing the samples The optimized formulation (F3) was stored at room temperature (25 ± 2°C) for 15 days and periodically examined for changes in colour, odour, appearance, texture, and pH. The observations are summarized in Table 5. while the stored samples are shown in Fig 5..

Fig 5. Herbal face mask formulations after 15 days of storage at room temperature, showing no visible changes in colour or physical appearance.

Table 5. Short-term stability evaluation of the herbal face mask formulations after storage at room temperature for 15 days.

Parameter	Initial	After 15 Days
Colour	No change	No change
Odour	Pleasant	Pleasant
Appearance	Fine powder	Fine powder
Texture	Smooth	Smooth
pH	6.4	6.4

DISCUSSION

The present study focused on the formulation and preliminary evaluation of a powder-based herbal face mask containing *Clitoria ternatea* flower powder along with selected herbal ingredients commonly used in cosmetic preparations. The formulation was designed to combine the cleansing properties of Multani mitti with the reported skin-beneficial phytochemicals of *Clitoria ternatea*, neem, aloe vera, rose petals, orange peel, beetroot, and rice powder. The overall findings indicate that the developed formulations possessed acceptable physicochemical characteristics and showed potential for use as a herbal cosmetic product.

Preliminary phytochemical screening confirmed the presence of flavonoids and anthocyanins in the prepared samples. These phytoconstituents are naturally abundant in *Clitoria ternatea* flowers and have been widely reported to possess antioxidant and anti-inflammatory properties that may contribute to skin protection [16,18,25,26]. The qualitative tests confirmed the presence of major bioactive constituents expected in the plant material.

The organoleptic evaluation demonstrated that all three formulations had acceptable colour, odour, texture, and overall appearance. A smooth, homogeneous powder without visible impurities is an important quality characteristic because it improves product acceptability and facilitates uniform application. The pleasant herbal odour obtained from the combination of rose petal powder and orange peel powder may also improve user acceptance of the formulation.

The pH of the optimized formulation (F3) remained unchanged (6.4) throughout the 15-day storage period which is close to the normal pH of facial skin. Maintaining a near-physiological pH is desirable because it helps preserve the skin barrier and reduces the possibility of irritation during topical applications. pH was measured using standard pH paper. The results indicated that all formulations were within an acceptable range for cosmetic use. Spreadability and washability are important quality attributes that influence the practical use of a face mask. All formulations spread uniformly after mixing with water and could be removed easily without leaving visible residue on the skin. Among the formulations, F3 demonstrated the best spreadability and overall

characteristics. This observation may be attributed to the balanced proportion of the powdered herbal ingredients, which produced a smoother and more uniform paste during application.

No visible signs of redness, itching, burning sensation, or swelling were observed during the preliminary skin compatibility assessment. These findings suggest that the formulations were well tolerated under the conditions of this initial evaluation. *Clitoria ternatea* flowers represent a valuable natural ingredient for herbal cosmetics and may serve as a promising candidate for the development of safe, effective, and plant-based skincare products.

The short-term stability study showed no noticeable changes in colour, odour, texture, appearance, or pH during storage at room temperature for 15 days. These observations indicate that the powder formulations remained physically stable throughout the study period. Nevertheless, longer-duration and accelerated stability studies are necessary to establish the shelf life and storage requirements of the formulation. The total ash value of 27.5% w/w reflects the mineral content of the formulation and is likely influenced by ingredients such as Multani mitti, which naturally contains inorganic minerals. Since the formulation is intended for topical cosmetic application rather than oral administration, the observed ash value is considered acceptable within the context of the present study.

The findings of this investigation are generally consistent with previous reports on herbal face masks containing *Clitoria ternatea* and other medicinal plants [1,7–13,20,21]. Earlier studies have also reported satisfactory physicochemical characteristics, acceptable skin compatibility, and favourable cosmetic properties of herbal formulations prepared using natural ingredients. The present study extends these observations by comparing three different formulations prepared with varying proportions of herbal ingredients and identifying F3 as the formulation with the most favourable overall characteristics. Future research on *Clitoria ternatea* flowers should focus on quantitative phytochemical analysis, antioxidant activity, microbial quality assessment, accelerated and long-term stability studies, and controlled clinical trials to further confirm the quality, safety, and effectiveness of the developed herbal face mask.

Conclusion

The present study successfully formulated and evaluated a powder-based herbal face mask containing *Clitoria ternatea* flower powder in combination with Multani mitti, rose petal powder, neem leaf powder, aloe vera powder, orange peel powder, beetroot powder, and rice powder. The developed formulations exhibited acceptable physicochemical characteristics, including a pleasant appearance, smooth texture, suitable pH, good spreadability, satisfactory washability, and favourable preliminary skin compatibility.

Qualitative phytochemical screening confirmed the presence of flavonoids and anthocyanins, supporting the selection of *Clitoria ternatea* as the principal herbal ingredient. Among the three formulations evaluated, F3 demonstrated the most desirable overall characteristics in terms of spreadability, physical appearance, and ease of application, while all formulations remained physically stable during the 15-day storage period. The findings of this study suggest that *Clitoria ternatea* has promising potential for the development of herbal cosmetic formulations intended for routine skin care. Additional investigations involving quantitative phytochemical analysis, antioxidant activity, microbiological quality assessment, long-term and accelerated stability studies, and controlled clinical evaluations are required to further establish the safety, efficacy, and commercial applicability of the herbal face mask.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Authors' Contributions

All authors contributed to the conception and design of the study, data compilation, manuscript preparation, revision, and approval of the final version of the manuscript.

AI Tool Declaration

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

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